DOCUMENT RESUME

ED 140 972 PS 009 357

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TITLE The Effects of High Risk Factors on Neonatal Behavior as Measured by the Brazelton Scale.
PUB DATE Mar 77
NOTE 13p.; Paper presented at the Biennial Meeting of the Society for Research in Child Development (New Orleans, Louisiana, March 17-20, 1977) ; This study was partially supported by a grant from the Sigma Xi Foundation

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Factor Analysis; *Infant Behavior; *Neonates; Performance Tests; *Physical Development; Predictive Ability (Testing); *Predictor Variables; *Screening Tests; Test Validity
IDENTIFIERS *Brazelton Neonatal Assessment Scale

ABSTRACT

The Brazelton Neonatal Behavioral Assessment Scale was administered to 143 healthy newborns. Infants were divided into average-superior and worrisome groups based on the rating of their performance on the "a priori" dimensions and overall profile. Twelve risk variables were entered into a stepwise discriminant analysis for each dimension and the overall profile. Each dimension was best predicted by a different combination of risk variables whose weights also varied across dimensions. Birthweight contributed to four of the discriminant analyses and was the single most powerful predictor for the dimension of motoric processes and the overall profile. The results indicate that the Brazelton Scale is differentially sensitive to factors associated with risk in the newborn and that the prediction of neonatal behavior can be increased by looking at combinations of variables rather than at single variables. (Author/MS)

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The Effects of High Risk Factors on Neonatal Behavior as Measured by the Brazelton Scale

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PS 009357

This paper was presented as part of a Symposium: A Panorama of Uses and Misuses of the Brazelton Neonatal Behavioral Assessment Scale, B.M. Lester (Chair.), at the Biennial Meeting of the Society for Research in Child Development, New Orleans, Louisiana, March, 1977. This study was partially supported by a grant from the Sigma Xi Foundation. We would like to express our gratitude to the administration and nursery staff of the Hospital Municipal of San Juan, Puerto Rico for their help and cooperation and to Lucy Lyons for her assistance in completing the project.

The Effects of High Risk Factors on Neonatal Behavior

as Measured by the Brazelton Scale

One of the uses of the Brazelton Scale as an outcome measure has been to assess the impact of various conditions associated with risk on neonatal behavior. Healthy newborns who may be at risk due to factors associated with growth and maturity have been found to differ in performance from low risk newborns. For example, Als et al. (1976) found that over the first ten days of life, full-term but small-for-gestational-age infants differed from full-term appropriate-for-gestational-age infants on the Brazelton dimensions of interactive and motoric processes as well as on the overall profile. Brazelton et al. (1976) looked at relations between specific background variables and neonatal performance among Guatemalan infants. Infant variables such as gestational age, birthweight and age of testing and maternal variables such as prolonged intervals between pregnancy and height were individually related to poor performance on clusters of the Neonatal Scale reflecting social interaction and neuromotor adequacy.

We wondered if, using multivariate procedures, we might be able to look at the predictive power of combinations of similar variables and to estimate the relative contribution of each variable in the prediction of neonatal behavior. In a previous study, Lester et al. (1976) found that the combination of birthweight, age of mother, sex and race of the infant predicted Brazelton Scale scores on an attention-orientation factor. Birthweight was the single best predictor.

In the present study we used multivariate techniques to tease out some of the synergistic relationships among indices of risk in predicting performance on the a priori Brazelton Scale dimensions. We were particularly interested in the relative contribution of measures of physical growth and maturity when compared with other potential estimates of risk on neonatal behavior. Our sample consisted of a heterogeneous group of 121 normal healthy babies recruited from the Hospital Municipal in San Juan, Puerto Rico. The number of maternal, parturitional and

fetal nonoptimal obstetric conditions was calculated for each infant according to a modification of the Prechtl (1968) scoring system. The mothers were native born Puerto Ricans of lower middle to lower socioeconomic status.

The Brazelton Scale was administered in a room near the nursery between one and three days of age by an examiner and scorer trained to reliability on the scale. The infants were scored on each of the four a priori dimensions and on the overall profile based on their ratings on the 26 items of the scale.

The data was analyzed using stepwise discriminant analyses. For each dimension infants were divided into two groups. Group 1 included infants rated as average or superior. Group 2 included those rated as deficient on that dimension. To compute an overall profile score, the ratings on the four dimensions were summed yielding a single score for each infant ranging from 4 to 12. Infants scoring 10 and above were placed in the worrisome group and below 10, in the average-superior group. The independent variables in the analyses were birthweight which ranged from 1,100 to 3,900 grams, gestational age ranging from 29 to 42 weeks, ponderal index which is a weight to length ratio indicating size-appropriateness for gestational age, number of maternal, parturitional and fetal nonoptimal conditions with the total ranging from 0 to 11, days of hospitalization at time of testing, sex, type of obstetrical medication, age of the mother ranging from 15 to 30 years, delivery type and duration of labor. The order of entry of each independent variable was determined by the amount of variance explained by that variable.

Table 1 illustrates the summary of the discriminant analysis for the Brazelton dimension, interactive processes, which reflects the infant's capacity to respond to social stimuli during the alert state. Items of orientation, cuddliness, alertness and consolability with intervention are used to define this dimension. Amount of hospitalization was entered first into the discriminant function equation followed by number of maternal nonoptimal conditions, labor duration and birthweight. As indicated by the standardized discriminant function coefficients, the relative contribution of each predictor variable was similar.

Table 2 shows the prediction results of the discriminant function for the dimension of interactive processes. By comparing the actual group classification with the predicted group membership based on the discriminant function, we can see that the discriminant function correctly classified 69% of the cases. About the same percentage of cases were correctly classified in group 1 and group 2.

Table 3 illustrates the summary of the discriminant analysis for dimension 2, motoric processes. Birthweight was entered first followed by labor duration, number of fetal nonoptimal conditions, number of parturitional nonoptimal conditions, delivery type, sex and ponderal index. As shown by the standardized discriminant function coeffecients, the major contributors to this dimension were birthweight, number of parturitional nonoptimal conditions and delivery type. These variables seem to predict the baby's ability to maintain adequate tone, control motor behavior and to perform integrated motor actions.

Table 4 shows the prediction results of the discriminant function for the dimension of motoric processes. 81% of the cases were correctly classified with a slightly better prediction rate for average-superior infants than for worrisome infants.

Table 5 illustrates the summary of the discriminant analysis for dimension 3, state control. This dimension reflects the infant's ability to organize its states and to shut out disturbing stimuli when asleep. The most powerful predictor of state control was gestational age followed by number of parturitional nonoptimal conditions, hospitalization and sex. The standardized discriminant function coefficients show that the relative contribution of each predictor followed their order of entry.

The prediction results of the discriminant function for dimension 3 are illustated in Table 6. 65% of the cases were correctly classified using this discriminant function. However, this represents a 74% "hit" rate for the average-superior group but only 53% for the worrisome group.

Table 7 shows the summary of the discriminant analysis for dimension 4,

the infant's physiological response to stress. This dimension includes items of tremulousness, startles and lability of skin color. Number of maternal nonoptimal conditions was entered first followed by number of fetal nonoptimal conditions, birthweight, labor duration and number of parturitional nonoptimal conditions. Number of fetal nonoptimal conditions, birthweight and labor duration made the greatest contribution to this dimension.

The prediction results of the discriminant function for dimension 4 are shown in Table 8. 66% of the cases were correctly classified with 63% for average-superior and 70% for worrisome infants.

Table 9 gives the summary of the discriminant analysis for the Brazelton Scale profile, the summary score of the four behavioral dimensions. Birthweight was entered first into the discriminant function followed by labor duration, number of maternal nonoptimal conditions and sex. Birthweight and labor duration made the greatest contribution.

Table 10 shows the prediction results of the discriminant function for the overall profile. 71% of the cases were correctly classified with about the same percentage for the average-superior and worrisome groups.

These results show the differential sensitivity of the Brazelton Scale dimensions to factors associated with at-riskness in the newborn. Each dimension was best predicted by a different combination of at-risk variables whose weights also varied across dimensions. To illustrate, birthweight was a substantial contributor to four of the discriminant analyses and was the single most powerful predictor for the dimension of motoric processes and the overall profile. Poor performance on the dimension of interactive processes was affected similarly by a high number of maternal nonoptimal conditions, short labor longer hospitalization and low birthweight whereas poor performance on the overall profile was primarily associated with low birthweight and short labor.

This study also shows that the prediction of neonatal behavior can be increased

by looking at combinations of variables rather than at single variables. Techniques such as discriminant anlyses enable us to evaluate synergistic relationships by determining how associated variables operate in concert. Moreover, these techniques take care of the problem of covariation among predictors by looking at the contibution of each variable while controlling for the contribution of the other variables. On the other hand, this technique is limited by the variables chosen for entry and may not generalize to the population.

Our results also show that we were able to correctly classify a significant number of infants rated as average-superior or deficient on all four dimensions of the scale and on the overall profile. However, the discriminating power of the functions ranged from 65% for state control to 81% for motoric processes. This may reflect the hierarchical organization of behavior to which the scale seems to be sensitive. Our next task then is to use this hierarchical organization of behavior in conjunction with at risk variables to predict the later developmental status of these infants.

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Table 1. Summary of stepwise discriminant analysis for Brazelton Scale Dimension 1 - Interactive Processes.

STEP NO.	VARIABLE	SIGNIFICANCE LEVEL	STANDARDIZED DICRIMINANT FUNCTION COEFFICIENT
1	Hospitalization	$< .05$	-.458
2	Maternal nonoptimal conditions	$< .05$	-.553
3	Labor duration	$< .05$	.525
4	Birthweight	$< .05$	.437

Table 2. Prediction results of discriminant function for Brazelton Scale Dimension 1- Interactive Processes

ACTUAL GROUP	NO. OF CASES	PREDICTED GROUP MEMBERSHIP GROUP 1	GROUP 2
1	89	69.7%	30.3%
2	32	34.4%	65.6%

Percent of "grouped" cases correctly classified: 68.60%

Canonical correlation = .318

Chi-square = 12.456 $p < .015$

Table 3. Summary of stepwise discriminant analysis for Brazelton Scale Dimension 2 - Motoric Processes

STEP NO.	VARIABLE	SIGNIFICANCE LEVEL	STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENT
1	Birthweight	$<.001$	-.720
2	Labor duration	$<.001$	-.242
3	Fetal nonoptimal conditions	$<.001$	.308
4	Parturitional nonoptimal conditions	$<.001$	-.540
5	Delivery type	$<.001$	.471
6	Sex	$<.001$	-.210
7	Ponderal Index	$<.001$	-.232

Table 4. Prediction results of discriminant function for Brazelton Scale Dimension 2 - Motoric Processes

ACTUAL GROUP	NO. OF CASES	PREDICTED GROUP MEMBERSHIP	
		GROUP 1	GROUP 2
1	96	82.3%	17.7%
2	25	24.0%	76.0%

Percent of "grouped" cases correctly classified: 80.99%

Canonical correlation = .549

Chi-square = 41.374 $p < .001$

Table 5. Summary of stepwise discriminant analysis for Brazelton Scale Dimension 3 - State Control

STEP NO.	VARIABLE	SIGNIFICANCE LEVEL	STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENT
1	Gestational age	$< .05$	.652
2	Parturitional nonoptimal conditions	$< .01$	-.438
3	Hospitalization	$< .05$	-.382
4	Sex	$< .05$	-.304

Table 6. Prediction results of discriminant function for Brazelton Scale Dimension 3 - State Control

ACTUAL GROUP	NO. OF CASES	PREDICTED GROUP MEMBERSHIP GROUP 1	GROUP 2
1	72	73.6%	26.4%
2	49	46.9%	53.1%

Percent of "grouped" cases correctly classified: 65.29%

Canonical correlation = .310

Chi-square = 11.805 $p < .05$ ..

Table 7. Summary of stepwise discriminant analysis for Brazelton Scale Dimension 4 - Physiological response to stress

STEP NO.	VARIABLE	SIGNIFICANCE LEVEL	STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENT
1	Maternal nonoptimal conditions	$< .01$	-.273
2	Fetal nonoptimal conditions	$< .01$	-.574
3	Birthweight	$< .01$	-.466
4	Labor duration	$< .01$	-.456
5	Parturitional nonoptimal conditions	$< .01$	-.323

Table 8. Prediction results of discriminant function for Brazelton Scale Dimension 4 - Physiological response to stress

ACTUAL GROUP	NO. OF CASES	PREDICTED GROUP MEMBERSHIP GROUP 1	GROUP 2
1	85	63.5%	36.5%
2	36	27.8%	72.2%

Percent of "grouped" cases correctly classified : 66.12%

Canonical correlation = .384

Chi-square = 18.619 $p < .01$

Table 9. Summary of stepwise discriminant analysis for Brazelton Scale Profile

STEP NO.	VARIABLE	SIGNIFICANCE LEVEL	STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENT
1	Birthweight	$< .001$	-.736
2	Labor duration	$< .001$	-.563
3	Maternal nonoptimal conditions	$< .001$	-.250
4	Sex	$< .001$	.222

Table 10. Prediction results of discriminant function for Brazelton Scale

ACTUAL GROUP	NO. OF CASES	PREDICTED GROUP MEMBERSHIP GROUP 1	GROUP 2
1	96	70.8%	29.2%
2	25	28.0%	72.0%

Percent of "grouped" cases correctly classified: 71.07%

Canonical correlation = .408

Chi-square = 21.275 $p < .001$